



Scoping Study

State Diesel Emission Inspection Programs:

Trends and Outcomes

Prepared for:

Diesel Technology Forum
Washington DC

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EXECUTIVE SUMMARY

Overview

Substantial progress has been made over the last decade in reducing emissions from heavy-duty diesel engines used in trucks and buses, and the newer engines are virtually smoke free. However, some fraction of the in-use fleet of heavy-duty diesel powered vehicles are improperly maintained or maladjusted and emit excessive smoke as well as other gaseous pollutants. In order to identify and repair such vehicles, heavy-duty diesel vehicle emission inspection programs have been initiated in a number of locations in the U.S. in the last decade. The earliest of these programs dates back to 1974 for the Arizona program, but most programs were initiated in the mid to late 1990s. At present, there are 16 programs in operation in the U.S., and two in Canada (in Toronto and Vancouver). All of the 18 programs in operation as of March 2004 measure smoke opacity only as a surrogate for diesel emissions, but program structures and test methods vary across states. In spite of the presence of so many diesel vehicle inspection programs, there has been virtually no analysis of their benefits and effectiveness outside of California. The EPA does not have any “official” method to estimate the emission benefits of diesel inspection programs, and currently offers no operational guidance on the parameters that define a well run and successful program. This study is a preliminary effort to document the data available from existing programs and to compare available results across programs.

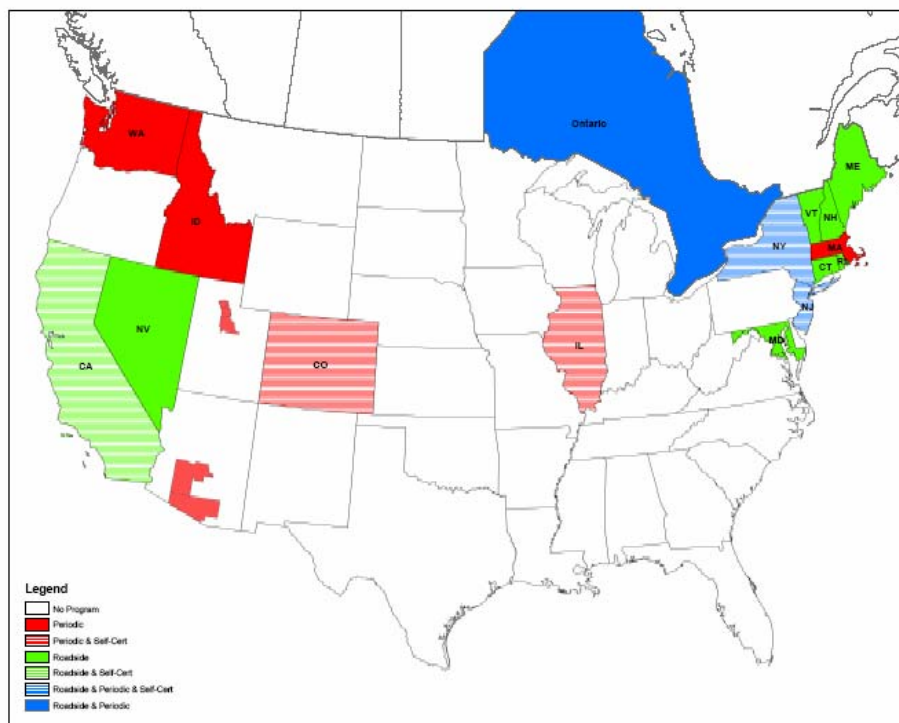
Program Details

At present, there are three specific types of programs used:

- a roadside inspection where a sample of all trucks is selected at varied locations for smoke opacity testing;
- a periodic inspection where trucks registered in a specific area are inspected annually or biennially at an inspection facility;
- a self certification program for fleets, which are allowed to conduct periodic tests in their own maintenance facility and report the results to the state.

The color-coded Map shows the type of program used in each state or county. Several states combine two of these generic types to obtain more comprehensive coverage of the target fleet. In particular, the New York and New Jersey programs blur the distinction between periodic programs, where tests are conducted by an independent facility, and self-certification programs, in that the operations are not distinct.

Most states use a test approved by the Society of Automotive Engineers for identifying a diesel vehicle’s smoke emissions, called the SAE J1667 “snap-acceleration” test, with pass/fail standards of 55 percent smoke opacity for pre-1991 vehicles and 40 percent for 1991 and later vehicles. The J1667 test and the standards have been endorsed by the EPA. Some states also use a 70 percent standard for pre-1974 vehicles, while Utah is unique in having only a 70 percent standard for all vehicles. Only two states - Arizona (Pima county) and Colorado- use the loaded mode lug down test with smoke opacity standards of 30 and 35 percent respectively.



Diesel Inspection Programs by Type

The number of vehicles tested annually varies greatly across states. Among those with periodic programs, Arizona and Colorado are the largest with each testing over 30,000 vehicles per year. Among the roadside programs, California is the largest with tests performed on over 18,000 vehicles annually. At the other end of the spectrum, some New England states test fewer than 500 vehicles per year.

All states collect data on the vehicles tested and test results in terms of measured smoke opacity. However, the quality and quantity of data collected varies significantly between states. In general, the older programs have well organized and relatively clean data bases in that truck make, model year, test results and pass/fail determination are unambiguous for most records. Even the best run programs do not have good data on truck weight and engine models. The newer roadside programs (almost all in the eastern states) acknowledge data problems in that many fields are incomplete and the data has not been quality checked, and are currently enhancing the quality of data collected. Data from self certification programs rarely show any trucks failing the inspection and the quality is unknown.

Conclusions

The conclusions of this preliminary study are:

- Available data shows that smoke inspection programs are effective in reducing both the number of very smoky vehicles and the average smoke opacity from any given model year's vehicles.

- The snap acceleration test with existing standards continues to be viable test for pre-1998 vehicles.
- Approximately 5 to 7 percent of pre-1998 vehicles record smoke emissions on the snap test in excess of standards, and this percentage increases somewhat with vehicle age.
- The lug down test with a 30 percent opacity standard is less effective than the snap test in that fewer vehicles exceed smoke opacity standards.
- 1998 and newer vehicles have significantly lower smoke emissions than pre-1998 vehicles partly due to improved engine technology.
- At the current time, none of the programs are using data analysis as a tool to enhance operational effectiveness or study potential problems in the program.

Recommendations

The findings above point to a number of areas for further analyses of program data. Data analysis can be a valuable tool to shed light on:

- Observed differences in opacity distributions between different states;
- The effectiveness of the J1667 test versus the lug down test;
- Alternative standards for both J1667 and lug down tests that can identify a larger portion of high emitters;
- Specific engine makes/models that are more prone to failing the tests;
- Improved opportunities for targeting likely failures in roadside programs.

At present, it appears that data from all periodic programs except New York and New Jersey have the sample size and data quality that will be useful for detailed analysis. About half the roadside programs will have adequate sample size and data quality for detailed analysis with data from the 2004 calendar year.

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1. INTRODUCTION

Substantial progress has been made over the last decade in reducing emissions from heavy-duty diesel engines used in trucks and buses, and the newer engines are virtually smoke free.

However, some fraction of the in-use fleet of heavy-duty diesel powered vehicles are improperly maintained or maladjusted and emit excessive smoke as well as other gaseous pollutants. In order to identify and repair such vehicles, heavy-duty diesel vehicle emission inspection programs have been initiated in a number of locations in the U.S. The earliest of these is the Arizona program, which dates back to 1974, followed by Colorado that initiated a program in 1987. Most of the other programs in operation currently were initiated in the early to mid-1990s. California started its program in 1991, but the program was shutdown for several years in the 1990s due to litigation and the development of the SAE J1667 test, and was restarted in 1998. This particular program and the test method used served as a model for many new programs initiated in the 1990s, largely because California conducted a number of studies on the emission test methods and the benefits of inspection. At present, there are 16 programs in operation (and one pilot program) in the U.S., and one in Canada in Toronto. A second Canadian program in Vancouver B.C. ceased operations in 2002 but was restarted very recently.

All of the 18 programs in operation as of March 2004 measure smoke opacity only as a surrogate for diesel emissions, but program structures and test methods vary across states. In spite of the presence of so many diesel vehicle inspection programs, there has been virtually no analysis of their benefits and effectiveness outside of California. In addition, there is little systematic analysis of the data being generated by these programs, with only a reporting of gross failure rates being common. More surprisingly, the EPA does not have any “official” method to estimate the emission benefits of diesel inspection programs, and offers no operational guidance on the parameters that define a well run and successful program. As a result, much of the initial analysis done in the late-1980s to establish the California program and estimate its benefit has been utilized by other states, with little new work completed to enhance the original California analysis.

This report documents a scoping study to examine the available data from the 18 programs, provide initial comparisons of results from these programs, and recommend data from specific programs that could be suitable for detailed analysis in a second phase of the study. At present, there are three specific types of programs used:

- a roadside inspection where a sample of all trucks is selected at varied locations for smoke opacity testing;
- a periodic inspection where trucks registered in a specific area are inspected annually or biennially at an inspection facility;
- a self certification program for fleets, which are allowed to conduct periodic tests in their own maintenance facility and report the results to the state.

Table 1-1 lists the 18 state programs and the type used in each state. Several states combine two of these types to obtain more comprehensive coverage of the target fleet. In particular, the New York and New Jersey programs blur the distinction between periodic programs, where tests are conducted by an independent facility, and self-certification programs, in that the operations are not distinct.

As can be seen from Table 1-1, most of the Western states, with the exception of California and Nevada, have opted for the periodic inspection program, while most of the Eastern states, with the exception of Massachusetts, have opted for the roadside inspection program. Self-certification is allowed in five states, and this type of program is employed in conjunction with either a periodic or a roadside program.

Naturally, the data collected cannot be compared across different program types since roadside programs can test non-random samples of vehicles, while periodic inspection programs test all vehicles registered in a particular area. In addition, the type, extent and quality of data collected by each program vary significantly. One objective of this scoping study was to evaluate the available data, and, hence, this is a focus of the report. The second is to document the results of available analyses of the data, and we have collected most of the published or publicly available reports on program performance.

TABLE 1-1
PROGRAM TYPE AND START DATE OF DIESEL INSPECTION PROGRAMS

	Program Type			Start Date	
	Roadside	Periodic	Self Certification	Pilot	Program
California	✓		✓	1986	1990/1998
Arizona		✓			1974
Utah		✓		1992	1995
Washington		✓			1993
Nevada	✓			1993	1996
Colorado		✓	✓		1987
Illinois		✓	✓		2000
Idaho		✓			1998
Maine	✓			1995	1997
New Hampshire	✓				1998
Vermont	✓			1996	1998
Massachusetts		✓			2001
Rhode Island	✓			2002	2004
New York	✓	✓	✓		2001
Connecticut	✓				1999
New Jersey	✓	✓	✓	1994	1998
Maryland	✓				2000
Ontario	✓	✓			1999

Note: New York's and New Jersey's periodic programs allow fleets to conduct their own test like a self-certification program, but the periodic and self certification programs are not distinctly separated, as in the other states.

Accordingly, Section 2 provides each program's operational details and data collected; the section is largely a series of tables that can be used as a quick reference. Section 3 summarizes the data from available program reviews and compares data across states and programs. Section 4 provides the conclusions and recommendations of this scoping study.

2. DOCUMENTATION OF PROGRAM CHARACTERISTICS AND DATA AVAILABILITY

A key factor in this scoping study is an estimate of the type and quality of data available from the different diesel inspection programs, for possible detailed analysis in a subsequent study. EEA contacted staff members in all 18 programs to obtain a listing of data available and, to the extent possible in this scoping analysis, provide an estimate of data quality.

Information obtained from our contacts is listed in a series of tables, one for each geographical area where programs are operational (Utah, for instance, has three separate tables for three different counties) but different within a state. The program in Rhode Island will not start until Summer 2004, and no table is provided for this program. Each table provides a quick summary of the program type, vehicles tested, when the program was initiated, and what data and reports are available. An indication of the gross failure rate reported is also listed for completeness. In several cases, states sent us sample of data or a year's worth of data, but detailed analysis of the databases was not possible within the resource constraints of this study.

Over main findings from the interviews and examination of data are:

- the only report widely available from most states is a simple listings of gross failure rates. Several states list failure rates by model year group or model year;
- all states collect data on vehicle make, model year and description (engine type, GVW, etc.) as well as the test results but data quality varies tremendously;
- the older programs (Arizona, California, Colorado) have well organized and relatively clean databases that should allow for good detailed analysis;
- in general, periodic inspection programs that occur at centralized facilities have the best data, but even here, fields indicating truck weight and engine model are often incomplete or erroneous;
- many of the newer roadside programs (almost all eastern states) acknowledge severe data problems at startup;
- several states with roadside programs are currently enhancing the quality and completeness of data collected. These states include New Hampshire, Maryland, and New Jersey;
- self-certification programs either have no data, or the data collected is largely useless for analysis;

- states that mix periodic inspection and self certification data (New York and New Jersey) have very incomplete and poor quality data;
- some locations – Connecticut and Ontario – will not release data at the individual truck level to third parties. It may be possible to obtain state or provincial approval to release data for analysis.

TABLE 2-1: ARIZONA PROGRAM (MARICOPA COUNTRY)

	Heavy Duty Diesel I/M Program Information	State: ARIZONA MARICOPA COUNTY
I.	How long has the program been operational?	Since 1974
	Is it Periodic or Roadside?	Periodic - Annual, Centralized
	What are the vehicles tested?	All 1967 and newer HDDV in the Phoenix metro area (Maricopa County)
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	55 % Opacity for 1990 and older 40 % Opacity for 1991 and newer
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2002 – 22934 inspections, 3.6% Fail Rate 2001 – 23117 inspections, 4.9% Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data:	
	— Truck Model Year	Yes
	— Make	Yes
	— Engine Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
	— Repair data	Yes
IV.	Is there an Annual Report Published/ Printed?	Yes (Statistical Report Only)
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	Yes
	— Repair or Re-test information	No
	— Cost of Repair	No

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TABLE 2-2: ARIZONA PROGRAM (PIMA COUNTRY)

	Heavy Duty Diesel I/M Program Information	State: ARIZONA PIMA COUNTY
I.	How long has the program been operational?	Since 1974
	Is it Periodic or Roadside?	Periodic - Annual, Centralized
	What are the vehicles tested?	All 1967 and newer HDDV in the Tucson metro area (Pima County)
II.	What is (are) the test used?	Loaded Opacity Test
	What are the Cut-off points (for Pass/Fail)?	30 % Opacity for 1967 and newer
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2002 - 7037 inspections, 3.8 % Fail Rate 2001 – 7235 inspections, 2.9% Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data:	
	— Truck Model Year	Yes
	— Make	Yes
	— Engine Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
	— Repair data	Yes
IV.	Is there an Annual Report Published/ Printed?	Yes (Statistical Report Only)
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	Yes
	— Repair or Re-test information	No
	— Cost of Repair	No

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TABLE 2-3: CONNECTICUT PROGRAM

	HEAVY DUTY DIESEL I/M PROGRAM INFORMATION	State: CONNECTICUT
I.	How long has the program been operational?	Since May 1999
	Is it Periodic or Roadside?	Roadside It is semi-random, trucks are not necessarily stopped only for visible smoke
	What are the vehicles tested?	Trucks over 26,000 lbs. GVW and diesel buses with 16 or more passenger capacity
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	40% opacity-1991 and newer 55% opacity- 1974 -1990: 55% opacity- 1973 and older (before 2003- 70%)
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2002 – 1847 inspections, 17% Fail Rate 2003 - 1447 inspections, 17% Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Database:	Yes
	— Truck Model Year	Yes
	— Make	Yes
	— Engine Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	No
	— Repair data	No
IV.	Is there an Annual Report Published/ Printed?	No
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

CONTACT NAME:

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TABLE 2-4: COLORADO PROGRAM

	Heavy Duty Diesel I/M Program Information	State: COLORADO
I.	How long has the program been operational?	January 1987 - for Fleets Since 1990 - for other vehicles
	Is it Periodic or Roadside?	Periodic- Annual 1. Diesel Opacity Insp. Prog (DOIP) - Decentralized 2. Diesel Fleet Self Certification Program (DFSCP) - In-house
	What are the vehicles tested?	Over 14,000 lbs. GVW
II.	What are the tests used?	1.DOIP - Heavy-duty lug down Dynamometer 2. DFSCP - 6 test options including SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	Dynamometer - 35% (Above 7000 Feet 40%) SAE J1667 - 40%
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	<u>DOIP</u> 2002 - 34322 inspections, 2% Fail Rate <u>DFSCP data</u> 2002 - 15,502 inspections, 0.7 % Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data:	
	— Truck Model Year	Yes
	— Make	Yes
	— Engine Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
	— Repair data	Yes
IV.	Is there a Annual Report Published/ Printed?	No (Non-electronic reports printed until 1999)
	—Failure rate by Model Year	Yes
	—Repair or Re-test information	Yes
	—Average Cost of Repair	Yes (Between \$290 -\$1260)

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TABLE 2-5: MAINE PROGRAM

	Heavy Duty Diesel I/M Program Information	State: MAINE
I.	How long has the program been operational?	Since 1997
	Is it Periodic or Roadside?	Roadside. Only the vehicles that appear to have excessive smoke are tested.
	What are the vehicles tested? (GVWR)	Vehicles over 18,000 lbs. GVW
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	70% opacity*- 1973 and older 55% opacity -1974-1990 40% opacity -1991 and newer *The 70% opacity standards sunsets in 2003 1973 and older vehicles will have to meet the 55% standard.
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	About 300 trucks were tested in the last two years, with a approximate fail rate of 78%.
	Is the test data available for individual truck tested?	No
	If yes, then Fields-Names for detailed Data:	
	— Truck Model Year	
	— Make	
	— Engine Make	
	— Test Results (for each or average)	
	— Re-test data	
	— Repair data	
IV.	Is there an Annual Report Published/ Printed?	No
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

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TABLE 2-6: MASSACHUSETTS PROGRAM

	Heavy Duty Diesel I/M Program Information	STATE: MASSACHUSETTS
I.	How long has the program been operational?	Since February 2001
	Is it Periodic or Roadside?	Periodic - Biennial, Decentralized
	What are the vehicles tested?	10,000 lbs. GVW and over; Vehicle model years 1984 and newer; At least 2 years old; Only Vehicles registered in MA and Federal Fleet assigned to MA. (Exempt vehicles: tactical military vehicles)
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	<u>Heavy-Duty Diesel Trucks:</u> 40% opacity - 1991 and newer 55% opacity - 1990 - 1984 <u>Diesel Buses/Motor Home:</u> 30% opacity - 1994 and newer 40% opacity - 1993 - 1984
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2002 - 29137 inspections, 2.6% Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data:	
	— Truck Model Year, Make	Yes
	— GVWR	Yes
	— Engine Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
	— Repair data	No
IV.	Is there an Annual Report Published/ Printed?	First report was published in 2003 (for 2002 data)
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	Yes
	— Repair or Re-test information	Yes
	— Cost of Repair	No

CONTACT NAME:

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TABLE 2-7: MARYLAND PROGRAM

	Heavy Duty Diesel I/M Program Information	State: MARYLAND
I.	How long has the program been operational?	Since July 2000
	Is it Periodic or Roadside?	Roadside
	What are the vehicles tested?	Vehicles 10,000 lbs. GVW and over
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	40% opacity - 1991 and newer 55% opacity - 1990-1974 70% opacity - 1973 and older
III.	Statistics:	Yes
	What are the gross Failure Rate/Year and number of tests conducted?	2001 - 2170 inspections, 15.7% Fail Rate 2002 - 1359 inspections, 18% Fail Rate 2003 - 848 inspections, 10.5% Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data:	
	— Truck Model Year	Yes
	— Make	Yes
	— Engine Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
	— GVW	No
	— Repair data	No
IV.	Is there an Annual Report Published/ Printed?	On Demand - computer output
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	Yes
	— Repair or Re-test information	Yes
	— Cost of Repair	No

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TABLE 2-8: ILLINOIS PROGRAM

	Heavy Duty Diesel I/M Program Information	State: ILLINOIS
I.	How long has the program been operational?	Since July 2000
	Is it Periodic or Roadside?	Periodic - Annual, and Roadside
	What are the vehicles tested?	16,000 lbs. GVW & over
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	40% opacity - 1991 & newer 55% opacity - 1990 & older
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2003 - 12,976 inspected 2002 - 13,705 inspected 2001 - 12,262 inspected Fail Rates for both the Programs were similar, about 8-9 % a few years ago. Now dropped to about 6-7%.
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data:	
	— Truck Model Year	Yes
	— Make	Yes
	— Engine Make	Yes
	— Test Results (for each or average)	Yes unless waived
	— Re-test data	No
	— Repair data	No. Such documentation is not required.
IV.	Is there a Annual Report Published/ Printed?	No
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

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TABLE 2-9: IDAHO PROGRAM

	Heavy Duty Diesel I/M Program Information	State: IDAHO
I.	How long has the program been operational?	Since 1998
	Is it Periodic or Roadside?	Periodic - Annual, Centralized
	What are the vehicles tested?	Vehicles 8500 lbs. GVW and over, registered in Ada county
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	40% opacity-1992 55%opacity - 1975-1991 70% opacity - 1965-1974
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	Approximately 4% Fail Rate in 2002
	Is the Test Data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data:	
	— Truck Model Year	Yes
	— Make	Yes
	— Engine Make	Not reliable
	— Test Results (for each or average)	Yes
	— Re-test data	Yes (unless waived)
	— Repair data	No
IV.	Is there a Annual Report Published/ Printed?	No
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

CONTACT NAME:

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TABLE 2-10: NEVADA PROGRAM

	Heavy Duty Diesel I/M Program Information	State: NEVADA
I.	How long has the program been operational?	Since 1996
	Is it Periodic or Roadside?	Roadside
	What are the vehicles tested?	Vehicles 10,001 lbs. GVW & over
II.	What is (are) the test used?	J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	40% opacity - 1991 or Newer 55% opacity - 1977 to 1990 70% opacity - 1970 to 1976
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2003 - 1259 inspections, 26.1% Fail Rate 2002 - 1174 inspections, 19% Fail Rate 2001 - 850 inspections, 28% Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data request:	
	— Truck Model Year, Make	Yes
	— GVWR	No
	— Engine Make, Year	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
	— Repair data	Yes
IV.	Is there an Annual Report Published/ Printed?	Yes. Quarterly -with very basic information.
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	Yes
	— Repair or Re-test information	No
	— Cost of Repair	Yes (Average ~ \$914)

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TABLE 2-11: NEW HAMPSHIRE PROGRAM

	Heavy Duty Diesel I/M Program Information	State: NEW HAMPSHIRE
I.	How long has the program been operational?	Since June 1998
	Is it Periodic or Roadside?	Roadside
	What are the vehicles tested?	All Trucks & Buses 10,000 lbs. GVW and over
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	40% opacity - 1991 & newer 55% opacity - 1974 -1990 70% opacity - 1973 & older
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2002 - 382 inspections, 24.3% Fail Rate 2001 - 1938 inspections, 7.4 % Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data:	
	— Truck Model Year	Yes
	— Make	Yes
	— Engine Make	Yes
	— GVWR	No
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
IV.	— Repair data	No
	Is there an Annual Report Published/ Printed?	No
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

CONTACT:

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TABLE 2-12: NEW YORK PROGRAM

	Heavy Duty Diesel I/M Program Information	State: NEW YORK
I.	How long has the program been operational?	Since 2001
	Is it Periodic or Roadside?	Periodic - Annual, Self Certified by Fleet; and Roadside
	What are the vehicles tested? (GVW)	Trucks & Buses 8,500 lbs. GVWR & over
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	70% opacity - 1973 and older; 55% opacity - 1974 to 1990; 40% opacity- 1991 and newer
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	Annual Inspection data is very poor. Roadside: In 2003 about 1,965 inspections (for 1991 & newer vehicles), 1.9% Fail Rate
		Annual Roadside
	Is the test data available for individual truck tested?	Incomplete Yes
	If yes, then Fields-Names for detailed Data:	
	— Truck Model Year	Yes
	— Make	Yes
	— Engine Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	No
	— Repair data	No
IV.	Is there an Annual Report Published/ Printed?	NA
	Would available with the following information be available:	
	— Failure rate by Model Year	~ 10% Fail Rate for 1974-1990 MY
	— Repair or Re-test information	No
	— Cost of Repair	No

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TABLE 2-13: NEW JERSEY PROGRAM

Heavy Duty Diesel I/M Program Information		State: NEW JERSEY	
I.	How long has the program been operational?	Since 1998	
	Is it Periodic or Roadside?	Periodic - Annual, fleets can self certify Roadside - Selection is semi-random	
	What are the vehicles tested?	Vehicles 18,000 lbs. GVR and above (as given by manufacturer) (Emergency & Contractor Vehicles exempted)	
II.	What is (are) the test used?	For Annual Inspection: Snap Acceleration Test, Rolling Acceleration Test, or Stall Test. For Roadside: SAE J1667 Snap Acceleration Test	
	What are the Cut-off points (for Pass/Fail)?	SAE J1667 Snap Acceleration Test cut points	
		Trucks: 70% opacity - 1973 & older 55% opacity - 1974-1990 40% opacity - 1991 & newer	Buses: 40% opacity - 1987 & older 30% opacity - 1988 & newer 30% opacity - Urban buses
III.	Statistics: What are the gross Failure Rate/Year and number of tests conducted?	About 75,000 trucks are tested per year per program Annual- Fail Rate is approximately 0.5% Roadside - Fail Rate is approximately 3-7% (1998 Fail Rate was 30%)	
	Is test data available for individual truck tested?	Yes	
	Data Elements for data collection:	Annual	Roadside
	— Truck Model Year, Make, State	Yes	Yes (No Make of truck)
	— GVWR	Yes (Actual)	As Registered by Owner
	— Engine: Make, Year, Family, Aspiration, displacement, HP,	Yes	Engine Make & Year
	— Rebuilt/Replacement Engine	Yes	Yes
	— Test Results	Yes	Yes
	— Re-test data	Yes	Yes
	— Repair data	Yes	No
	— Cost and type of repair	Yes	No
IV.	Is there an Annual Report Published/ Printed?	No	
	Would the following be available:		
	— Failure rate by Model Year		
	— Repair or Re-test information		
	— Cost of Repair		

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TABLE 2-14: ONTARIO, CANADA PROGRAM (ANNUAL)

	Heavy Duty Diesel I/M Program Information	State: ONTARIO, CANADA
I.	How long has the program been operational?	Since September 1999
	Is it Periodic or Roadside?	Periodic - Annual
	What are the vehicles tested?	All Trucks and Buses over 9900 lbs. GVW; and older than three model years.
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	40% opacity - 1991 and newer 55% opacity - 1990 models and older (Expected to change from April 1 st 2004)
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2002 - About 135,000 inspections, 3.1% Fail Rate Data for other years not released. Estimated to be similar.
	Is the test data available for individual truck tested? If yes, then Fields-Names for detailed Data:	Yes
	— Truck Model Year, Make	Yes
	— Engine Make, Size	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	No
	— Repair data	No
IV.	Is there an Annual Report Published/ Printed?	NA
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

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TABLE 2-15: ONTARIO, CANADA PROGRAM (ROADSIDE)

	Heavy Duty Roadside Program Information	State: ONTARIO, CANADA
I.	How long has the program been operational?	Since 1998
	Is it Periodic or Roadside?	Roadside
	What are the vehicles tested?	Vehicles 9900 lbs. GVW or over Visual observations for visible emissions and tampering
II.	What is the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	40% opacity - 1991 and newer 55% opacity - 1990 and older (Expected to change from April 1 st 2004)
III.	Statistics:	(Statistics include inspections on HD gas vehicles)
	What are the gross Failure Rate/Year and number of tests conducted?	2002 - 141 inspections, 24% Fail Rate 2003 - 958 inspections, 19% Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then are the following Fields-Names 'captured' for data collection:	
	— Truck Model Year, Make	Yes
	— GVW	Yes
	— Engine Model Year, Make	No
	— Test Results (for each or average)	Yes
	— Re-test data	No
	— Repair data	No
IV.	Is there an Annual Report Published/ Printed?	No
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

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TABLE 2-16: UTAH PROGRAM (DAVIS COUNTY)

	Heavy Duty Diesel I/M Program Information	State: UTAH DAVIS COUNTY
I.	How long has the program been operational?	Since 1995
	Is it Periodic or Roadside?	Periodic - Annual, Centralized
	What are the vehicles tested?	26,000 lbs. GVW and over Only those that are registered in Davis County Except if vehicle is part of Fleet and has 50% of its miles out of state and is 3 years or newer.
II.	What is the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	70% opacity - general standards for all Model Year Diesel Engines
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2003 - 749 inspections, 5% Fail Rate 2002 - 753 inspections, 3.4% Fail Rate 2001 - 825 inspections, 4.1% Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then are the following Fields-Names available:	
	—Truck Model Year, Make	Yes
	—GVW	Yes
	—Engine Model Year, Make	Yes
	—Test Results (for each or average)	Yes
	—Re-test data	NA
	—Repair data	No
IV.	Is there an Annual Report Published/ Printed?	No
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

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TABLE 2-17: UTAH PROGRAM (SALT LAKE COUNTY)

	Heavy Duty Diesel I/M Program Information	State: UTAH SALT LAKE COUNTY
I.	How long has the program been operational?	Since mid 1990's
	Is it Periodic or Roadside?	Periodic - Annual, Centralized
	What are the vehicles tested?	Vehicles 16,000 lbs. GVW and over Except if vehicle is 6 years or newer, then it is tested every other year.
II.	What is the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	70% General Standards for all Model Year Diesel Engines
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	About 10,000 inspections, with 5% fail rate.
	Is the test data available for individual truck tested?	Yes
	If yes, then are the following Fields-Names available:	
	— Truck Model Year, Make	Yes
	— GVW	Yes
	— Engine Model Year, Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
	— Repair data	No
IV.	Is there an Annual Report Published/ Printed?	No
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

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TABLE 2-18: UTAH PROGRAM (UTAH COUNTY)

	Heavy Duty Diesel I/M Program Information	State: UTAH UTAH COUNTY
I.	How long has the program been operational?	Since 1995
	Is it Periodic or Roadside?	Periodic- Annual, Centralized
	What are the vehicles tested?	Vehicles 16,000 lbs. GVW & over Only those that are registered in Utah County Except if vehicle is 6 years or newer, then it is tested every other year.
II.	What is the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	70% General Standards for all Model Year Diesel Engines
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2003 - 2311 inspections, 7.27% Fail Rate 2001 - 2516 inspections, 2.2% Fail Rate 2000 - 2447 inspections, 4.5% Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then are the following Fields-Names available:	
	— Truck Year, Make	Yes
	— GVW	No
	— Engine Model Year, Make	No
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
	— Repair data	No
IV.	Is there an Annual Report Published/ Printed?	Yes
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	No
	— Repair or Re-test information	No
	— Cost of Repair	No

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TABLE 2-19: VERMONT PROGRAM

	Heavy Duty Diesel I/M Program Information	State: VERMONT
I.	How long has the program been operational?	Since October 1998 - Voluntary program (Pilot Program: Oct 96-98)
	Is it Periodic or Roadside?	Roadside
	What are the vehicles tested?	Vehicles 8,500 lbs. GVWR and over Visual Screening by visible smoke No penalties currently
II.	What is (are) the test used?	SAE J1667 Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	40% opacity - 1991 and newer 55% opacity - 1990 and older
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	No results have been released. Less than 400 trucks have been tested since start.
	Is data collected for individual trucks tested?	Yes
	If yes, then are the following Field-Names part of the collected data:-	
	— Truck Model Year, make	Yes
	— GVW	Yes
	— Engine Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	No
	— Repair data	Yes
IV.	Is there an Annual Report Published/ Printed?	Yes - Report from Pilot program only.
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

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TABLE 2-20: WASHINGTON PROGRAM

	Heavy Duty Diesel I/M Program Information	STATE: WASHINGTON
I.	How long has the program been operational?	Since 1993
	Is it Periodic or Roadside?	Periodic - Biennial, Centralized
	What are the vehicles tested?	Vehicles 8500 lbs. GVW and over Registered in Washington State More than 5 and less than 25 years old
II.	What is (are) the test used?	J1667-Snap Acceleration Test
	What are the Cut-off points (for Pass/Fail)?	1978-1991 -55% 1992 and newer: 40% For testing above 1,000 feet, allow additional 10%
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	2000 - 13646 inspections, 5% Fail Rate 2001 - 14,023 inspections, 4% Fail Rate
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data:	Yes
	— Truck Model Year, Make	Yes
	— GVW	No
	— Engine Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
	— Repair data	No
IV.	Is there an Annual Report Published/ Printed?	No
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	
	— Repair or Re-test information	
	— Cost of Repair	

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TABLE 2-21: CALIFORNIA PROGRAM

	Heavy Duty Diesel I/M Program Information	STATE: CALIFORNIA
I.	How long has the program been operational?	Started in 1991, restarted in 1998
	Is it Periodic or Roadside?	Roadside and Fleet Self Certification
	What are the vehicles tested?	>6000 lbs. GVW
II.	What is (are) the test used?	SAE J1667 Snap Acceleration
	What are the Cut-off points (for Pass/Fail)?	55% opacity for 1990 and older 40% opacity for 1991 and newer
III.	Statistics:	
	What are the gross Failure Rate/Year and number of tests conducted?	Roadside inspections are about 18,000 per year. 2003 - 6.5% fail rate 2002 - 6.9% fail rate
	Is the test data available for individual truck tested?	Yes
	If yes, then Fields-Names for detailed Data:	Yes
	— Truck Model Year, Make	Yes
	— GVW	No
	— Engine Make	Yes
	— Test Results (for each or average)	Yes
	— Re-test data	Yes
	— Repair data	Yes
IV.	Is there an Annual Report Published/ Printed?	Yes
	If yes, would that be available with the following information:	
	— Failure rate by Model Year	Yes
	— Repair or Re-test information	No
	— Cost of Repair	No

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3. SUMMARY OF AVAILABLE DATA ON FAILURE RATES

3.1 OVERVIEW

Most of the programs in operation collect data on the tests conducted that specify vehicle make/model year and in some case engine and GVW. As noted in Section 2, the engine and GVW data are more error prone and difficult to correct, but overall failure rates, and rates by model year are easier to compute with relatively good accuracy. There is a major difference between periodic and roadside programs in that many roadside programs do not test a random sample of vehicles but target likely failures. Since smoke opacity can be easily observed visually, a prescreening can take place so that smoky vehicles are preferentially tested with resulting high failure rates. Even a random sample on the roadside will likely yield more smoky trucks than a periodic inspection lane, due to the evasion of periodic inspection by some operators and the phenomenon of pre-repair or maintenance prior to inspection. Hence, reported failure rates are discussed below for each program type separately.

All of the programs use measured smoke opacity as the determinant of vehicle pass/fail status on the inspection test, but two different test procedures are in use. The most commonly used test is one developed by the Society of Automotive Engineers and this test is referred to as the SAE J1667 snap-acceleration test. The J1667 test has been endorsed by the EPA. The other test is the lug-down test, which is conducted on a dynamometer. Specific pass/fail standards for smoke opacity are applicable to each test type, but these standards vary by state, as described below.

3.2 PERIODIC INSPECTION PROGRAMS

The oldest of the periodic inspection programs in Arizona covers vehicles registered in Maricopa and Pima counties. The two locations use different tests: the one in Maricopa County uses the J1667 snap acceleration while Pima County uses the loaded mode lug down test. Due to the long history of the program, failure rates have reached a “steady state”. Data from Maricopa County show a gross failure rate of 3.3 percent in 2002 increasing to 4.5% in 2003. The increase is surprising and counter to the trends in other locations, and was traced to an unusual increase in the failure rates for the 1993–1996 trucks. Pima County, which uses a totally different test

procedure, reported a similar failure of 3.6 percent in 2002, but showed failure rates falling to 2.56 percent in 2003.

The Colorado DOIP periodic inspection program also uses the lug-down test used in Pima County, and the reported failure rates for 2001 and 2002 are 2.9 and 2.7 percent respectively, quite similar to the rate in Pima. However, the opacity standards are quite different: 20 percent opacity in Pima, 35 percent opacity in Denver. This identical failure rate inspite of a much higher opacity standard in Denver could be due to the altitude effect, since Denver is at 5000 feet altitude. In contrast, Colorado's self-certification program reports a very low failure rate of 0.75 percent.

All other locations use the SAE J1667 test, but some have different pass/fail standards. Failure rates in Utah's programs in Davis and Utah counties are also somewhat different from each other but are reasonably similar to the Maricopa county rate at about 4 ± 1 percent. In both counties, there is an upturn in the failure rate between 2002 and 2003, similar to the trend in Maricopa. However, the opacity standards are a very lax 70 percent opacity for all vehicles in Utah as opposed to 40 percent in Maricopa for 1991 and later vehicles. Opacity data provided by Utah suggests that the failure rate would be 35 percent at the 40% opacity limits. This huge differential in smoke opacity distribution is not explainable easily.

More recently started programs in Illinois, Washington and Ontario show a declining trend in failure rates over time, with 2002 calendar year failure rates also being in the 4 ± 1 percent range. These states use pass/fail opacity cutpoints that are very similar to those used in Maricopa County, but there is no upturn in the failure rate for calendar year 2003 in Illinois

New Jersey's data shows very low reported failure rates (around 0.5 percent) but this is due to the fact that a majority of vehicles in the periodic inspection program are in fleets that can self certify the results. No data is available from New York, which has not yet automated record collection from fleets.

Failure rates are summarized in Table 3-1, and an indication of the approximate total number of trucks tested is also shown. Table 3-2 shows rate failure by model year group for two states that provided such data: Arizona and Washington. The Arizona data shows an increasing failure rate

TABLE 3-1
REPORTED GROSS FAILURE RATE COMPARISONS
PERIODIC INSPECTIONS

State	Program	2001	2002	2003	Trucks Tested
Arizona	Maricopa	N/A	3.29	4.48	~22,000
	Pima	N/A	3.62	2.56	~7,000
Colorado	DOIP	2.90	2.71	N/A	~34,000
	DSCP	0.74	0.75	N/A	~15,500
Massachusetts	Statewide	--	2.60	N/A	~29,000
Utah	Davis	4.12	3.34	5.07	~800
	Utah	4.50	2.22	7.27	~2500
Illinois	Chicago	7.78	5.04	3.13	~13,000
New Jersey	Statewide	~0.50	~0.50	N/A	~75,000
Washington		5.02	4.12	N/A	~14,000
Ontario	Toronto	4.20	3.10	N/A	135,000

N/A – Not Available.

TABLE 3-2
FAILURE RATES BY MODEL YEAR GROUP (%)
PERIODIC CENTRALIZED PROGRAMS

Model Year Group	Arizona (Maricopa)	Washington[*]
Pre-1988	6.29	3.92
1988 – 1990	4.96	2.86
1991 – 1993	5.74	3.48
1994-1997	4.08	5.61
1998+	2.23	Not tested

^{*} Model year data may be in error.

with age (the pre-1991 vehicles have to meet a less stringent opacity standard), but the Washington failure rates are very variable. The Washington program requires biennial inspections, which may skew sequential calendar year comparisons.

3.3 ROADSIDE PROGRAMS

Roadside inspections were first initiated in California to target the large population of interstate and inter-county trucks, as well as the local fleet, for cleanup. In the first year of the program (1991), a random survey of trucks at different locations suggested that over 22 percent of vehicles could fail the smoke test at a 55% opacity cutpoint. Within two years, the proportion of smoky trucks had fallen to below 15 percent.

Since the advent of stringent PM standards as of 1994, failure rates have continued to fall and the majority of trucks have very low levels of smoke in calendar year 2004. In most roadside programs, a few teams of inspectors (one to six) move around the state or county to different locations and test vehicles, typically at truck stops or weigh stations. In the early 1990s, inspectors had no trouble finding smoky trucks for testing and these were preferentially targeted. In the last few years, smoky trucks are difficult to find, and roadside teams are simply testing a majority of trucks available except vehicles that appear very new. Hence, failure rates have fallen from over 60 percent in earlier times to levels approaching those found in periodic programs.

In general, data collection on vehicle characteristics is not very good in many programs, although California's data appears quite robust given the 10+ years of experience in program operation.

California provided data from their roadside program where about 18,000 trucks are inspected with "quick snaps" annually. Failure rates in the fourth quarter of 2003 and 2002 were 6.5 and 6.9 percent respectively, with the southern half of the state reporting a higher failure rate (over seven percent) relative to the northern half (under six percent). This difference is due to the higher prevalence of Mexican trucks in the south with somewhat higher failure rates than those for U.S. trucks.

Nevada has two enforcement units in the Las Vegas area, while enforcement in Reno expected to start in 2004. Tests are targeted to potential failures in Nevada and the current reported failure rate is 25 percent. About 1000 trucks are tested per year and failure rates in the last three years were 26.1 percent, 19.0 percent and 27.9 percent respectively. However, Nevada reports that only one to two percent of “observed” trucks would likely fail the test. Data by model year shows most failures to be concentrated in the pre-1991 model year vehicles.

The smaller New England states of Vermont, New Hampshire and Maine have only one or two teams of inspectors and very few tests are conducted per year, amounting to one to two per working day.* This allows a targeting of trucks likely to fail the test. As a result, failure rates are 78 percent Maine, similarly high in Vermont (their program is voluntary) and 23 percent in New Hampshire for 2002. In general, data from these states do not offered much opportunity for detailed analysis due to the limited sample size. However, New Hampshire will be expanding its program considerably in 2004.

Illinois’s program is conducted by the state highway police and it appears that the tests are administered to virtually all truckers inspected for safety or stopped for other violations. Hence, the reported failure rate of six to seven percent in the last two years is similar to (but somewhat higher than) the failure rates in the periodic inspection. Unfortunately, no detailed truck data is collected and reported in an electronic database for this program.

New Jersey’s roadside inspection program is also selecting trucks almost randomly and reports failure rates of five to seven percent (exact figure not available) in 2003. This represents a steep decline from the 30+ percent reported in 1998. New Jersey also provided average opacity data by model year from the pre-enforcement period (1994 – 1997) and from calendar year 2003 as shown in Figures 3-1 and 3-2. The opacity reductions in older trucks are striking.

* This is changing in 2004 in New Hampshire.

FIGURE 3-1

NEW JERSEY

**Roadside Pre-enforcement Inspection Years 1994 - 1997
Opacity vs Engine Year (NJ only)**

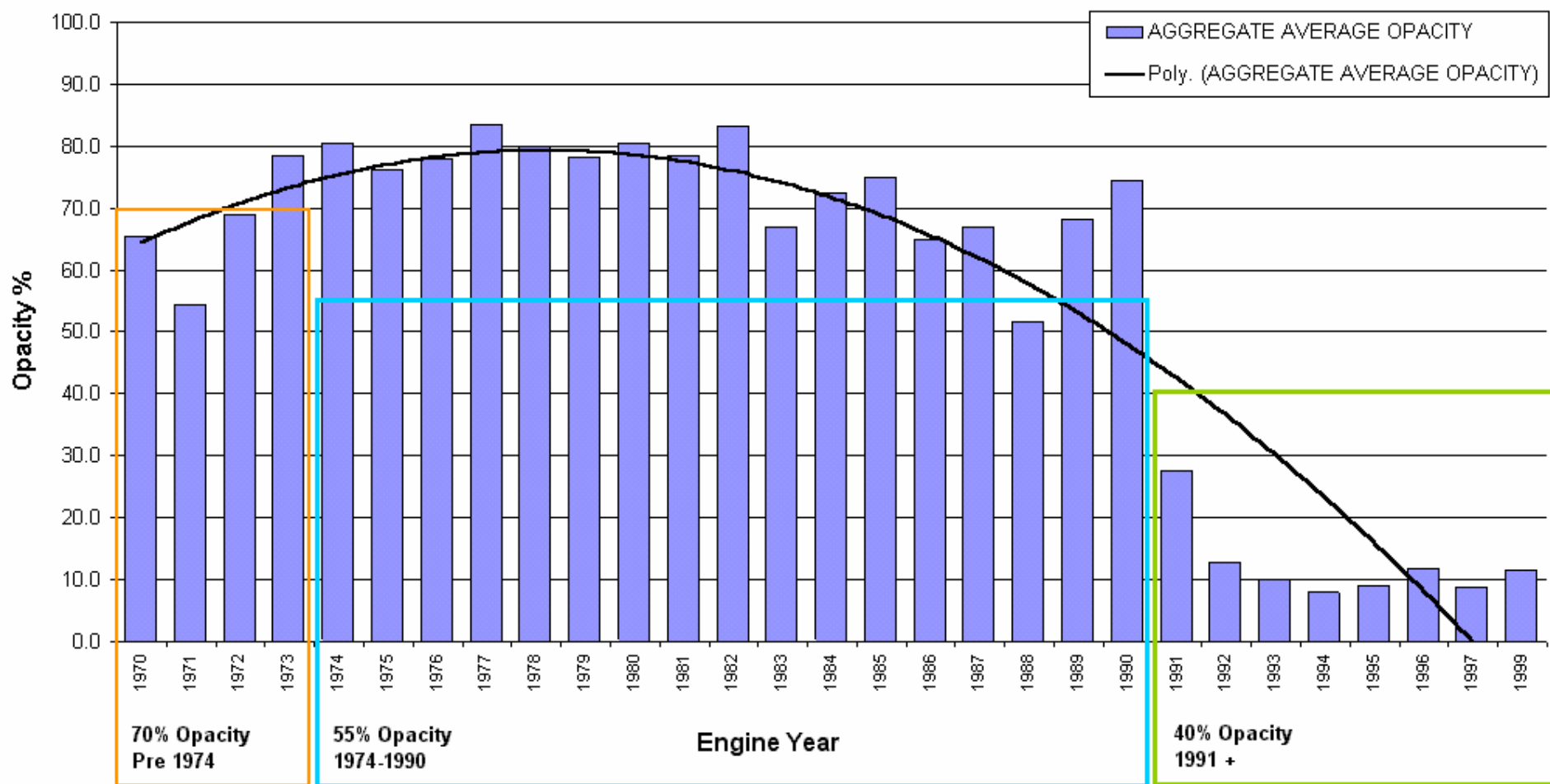
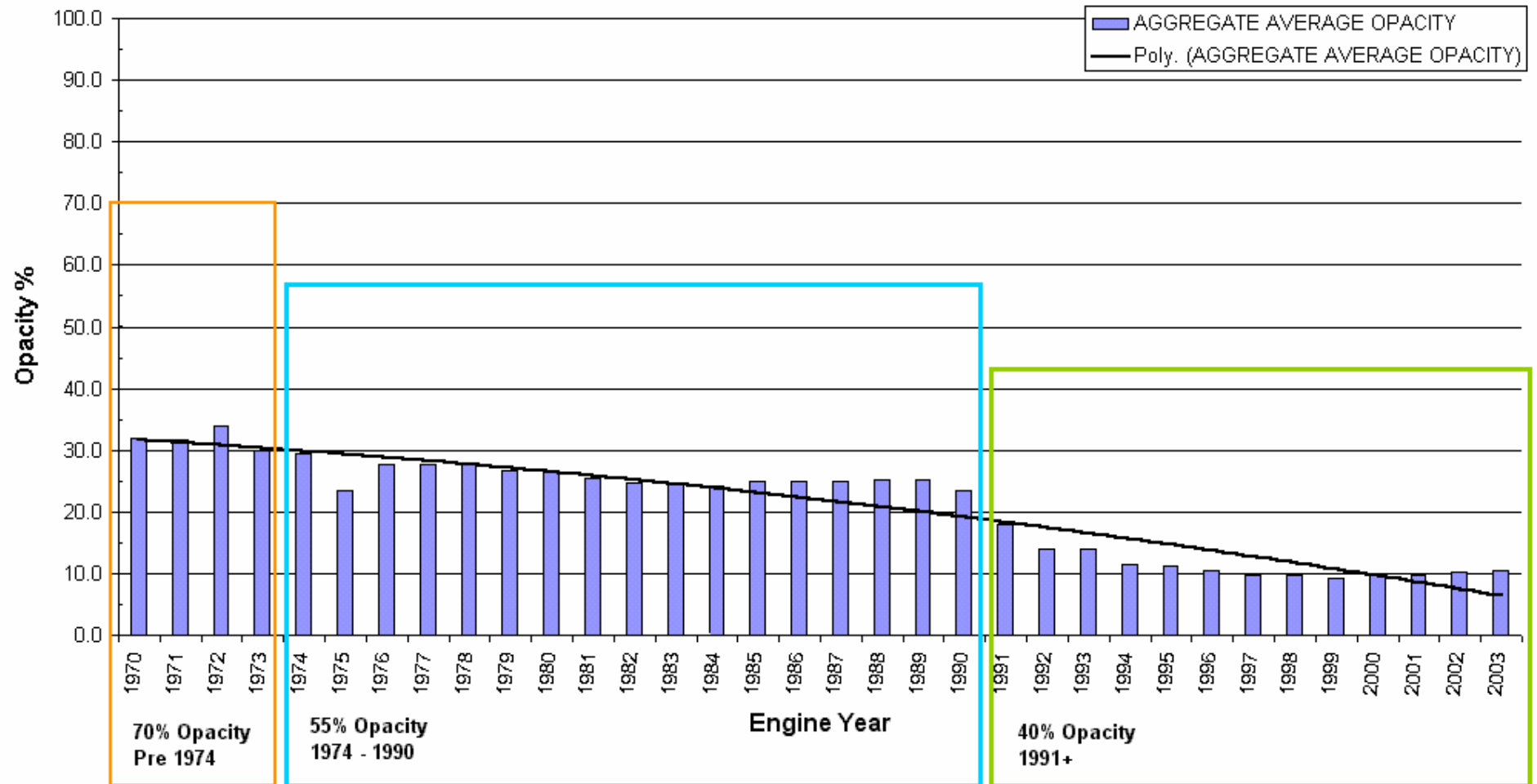


FIGURE 3-2

NEW JERSEY

**DEIC Inspections CY2003
Opacity vs Engine Year**



New York's roadside inspection program data proved difficult to access and we were unable to assess its usefulness and completeness. We obtained data verbally on failure rates as "about ten percent" on pre-1990 trucks and "about two percent" on pre-1990 trucks. Around 2000 trucks are tested per year in the state with the majority in the New York Metropolitan area, but little attention has been paid to the data integrity issues.

Connecticut tests vehicles over 26,000 lb. GVW and, hence, many of the smaller trucks used for pick-up and delivery are excluded. The tested trucks are not targeted only for smoke and the sample falls between a targeted and random sample. Connecticut reported failure rates of 17 percent in 2002 and 2003, and 16 percent in 2001. Approximately 1500 tests were conducted per year in the last two years.

Maryland tests vehicles over 10,000 lb. GVW with most tests conducted by the state police. Due to security concerns, the state police have shifted resources away from smoke testing and the number of tests fell from 2170 in 2001 to 1359 in 2002 and 848 in 2003. (Maryland hopes to reverse this trend in 2004.) Reported failure rates have also declined from 15.7 percent in 2001 to 10.5 percent in 2003, and the current sample appears to be closer to a random sample. Maryland authorities are not clear why failure rates on targeted trucks are so low.

In summary, it appears that there is considerable variation in the truck selection process for random roadside testing across states. In some states, the failure rates appear to be only slightly higher than those from periodic programs where all trucks are tested, but in others (especially those with few tests conducted) rates can be over 60 percent.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

There are 17 states and two Canadian provinces with diesel emissions inspections programs in North America. Several states have more than one program and some have several independent programs in different counties.

There are ten periodic (annual or biennial) inspection programs for all heavy-duty diesel vehicles registered in a specific area. There are 11 roadside inspection programs of which three overlap with periodic programs (New York, New Jersey and Ontario). Five states also have fleet self-certification programs that are either part of the periodic inspection program or operated as a separate program. Diesel vehicles covered by the different programs vary; some have a minimum weight of 6000 or 8,500 lb. GVW while other states set the lower limit to levels as high as 26,000 lb. GVW. Hence, the population of inspected trucks can differ greatly from state-to-state.

While most programs use the J1667 snap acceleration test, two programs (Colorado and Arizona/Pima County) use the lug down test. In addition, most programs using the J1667 test also use the 40 percent opacity level for 1991+ vehicles and 55 percent opacity level for pre-1991 vehicles as pass/fail standards. There are some exceptions: Utah uses a 70 percent cutpoint for all diesel vehicles, while several states use the 70 percent standard for older vehicles (pre-1980).

All states collect data on the vehicles tested and test results in terms of measured smoke opacity. However, the quality and quantity of data collected varies significantly between states. In general, the older programs have well organized and relatively clean data bases in that truck make, model year, test results and pass/fail determination are unambiguous for most records. Even the best run programs do not have good data on truck weight and engine models. The

newer roadside programs (almost all in the eastern states) acknowledge data problems in that many fields are incomplete and the data has not been quality checked, and are currently enhancing the quality of data collected. Data from self-certification programs rarely show any trucks failing the inspection and the quality is unknown.

The percent of vehicles exceeding applicable smoke opacity standards as reported by periodic programs are generally in the 4 ± 1 percent range in calendar years 2002/2003. While this may seem logical at first glance, the results are independent of test procedure used and pass/fail standards!

Roadside programs report 6 to 78 percent of vehicles exceeding applicable smoke opacity standards depending on how the inspection teams target vehicles selected for testing. However, officials in areas reporting rates under ten percent could not easily explain why the rate was so low as their teams were also told to target smoky trucks preferentially. In some cases, testing is conducted by state police. The police may be testing all vehicles stopped for any reason (speeding, safety violations, etc.)

Data from self-certification programs, where available, indicate near zero (less than one percent) failure rates and do not appear to be a useful indicator of the actual percent of vehicles exceeding standards. Lastly, all available data consistently shows large reductions in the number of smoky trucks due to the institution of a periodic or roadside program. While some of the reduction in smoky trucks is due to the introduction of new technology vehicles, there is documented evidence to support the conclusion that the average opacity from a given model year's vehicles is reduced significantly due to the institution of an inspection program.

The conclusions of this preliminary study are:

- Available data shows that smoke inspection programs are effective in reducing both the number of very smoky vehicles and the average smoke opacity from any given model year's vehicles.

- The snap acceleration test with existing standards continues to be viable test for pre-1998 vehicles.
- Approximately 5 to 7 percent of pre-1998 vehicles record smoke emissions on the snap test in excess of standards, and this percentage increases somewhat with vehicle age.
- The lug down test with a 30 percent opacity standard is less effective than the snap test in that fewer vehicles exceed smoke opacity standards.
- 1998 and newer vehicles have significantly lower smoke emissions than pre-1998 vehicles partly due to improved engine technology.
- At the current time, none of the programs are using data analysis as a tool to enhance operational effectiveness or study potential problems in the program.

4.2 RECOMMENDATIONS

The conclusions above point to a number of possible areas for further analyses of program data. At the current time, none of the programs are using data analysis as a tool to enhance operational effectiveness or study potential problems in the program. As far as we could ascertain, data is currently used merely to report gross failure rates or failure rates by model year.

Data analysis can offer a number of useful and interesting findings to the following questions:

- Observed differences in opacity distributions between different states;
- The effectiveness of the J1667 test versus the lug down test;
- Alternative cutpoints for both J1667 and lug down tests that can identify a larger portion of high emitters;
- Specific engine makes/models that are more prone to failing the tests;
- Improved opportunities for targeting likely failures in roadside programs.

At present, it appears that data from all periodic programs except New York and New Jersey have the sample size and data quality that will be useful for analysis. About half the roadside programs will have adequate sample size and data quality for detailed analysis, with 2004 calendar year data. The roadside programs where data is not yet useful are Maine, New

Hampshire and Vermont (where the number of vehicles tested is very small) and Connecticut, where the data may not be publicly available.

EEA recommends that these questions be addressed in a second phase of this work effort.